

# High-Efficiency, Ka-Band Solid-State Power Amplifier Utilizing GaN Technology, Phase II

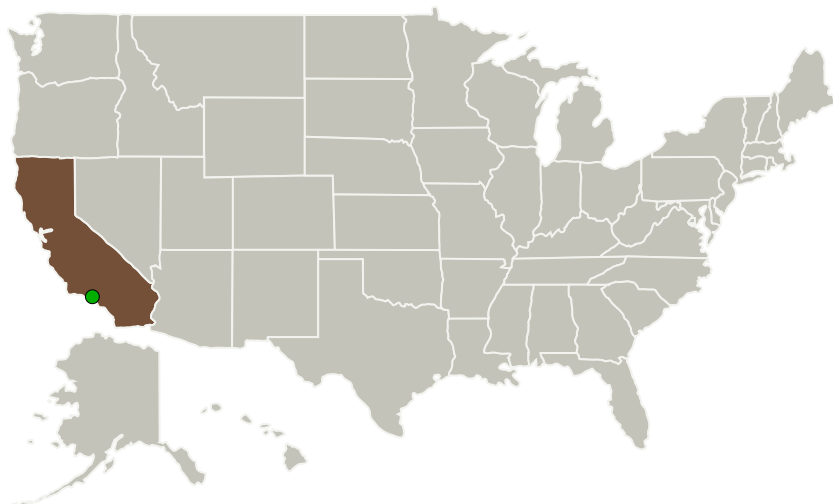
Completed Technology Project (2015 - 2018)



## Project Introduction

QuinStar Technology proposes to develop a high-efficiency, solid-state power amplifier (SSPA), operating at Ka-band frequencies, for high data rate, long range space communications. Specifically, we propose to develop a 20 W power amplifier with an associated PAE of 60% operating over the 31.5 to 34 GHz band. This will be accomplished by employing two major innovations. First, we plan to utilize wide bandgap Gallium Nitride (GaN) on Silicon Carbide (SiC) device technology to fabricate our high-efficiency MMICs. Operating at a higher voltage (typically 20-28 V versus 4-5 V for GaAs), GaN permits power densities which are 5-10 times higher than GaAs or InP. In addition to a higher power density, high-voltage operation results in lower matching and cell combining losses, making these MMICs more efficient. Secondly, we are proposing to utilize a switching mode of operation (Class-F) to enhance the device efficiency. While this method has demonstrated PAE levels of >80% at 2 GHz, these levels have not yet been realized at Ka-band frequencies. Computer simulations, contained in this proposal, indicate that by using this method, device PAE levels ranging up to 73% are possible at 32 GHz. Furthermore, this was verified by benchmark data from at least one GaN foundry showing a device, operating in Class-F, with a PAE of 80% at 3 GHz. Finally, simulations at Ka-band frequencies indicate that even with circuit losses, we can still maintain the efficiency (PAE) at or very close to 60%. The layout and performance of a multistage MMIC is included in this proposal, together with the overall SSPA configuration and performance.

## Primary U.S. Work Locations and Key Partners



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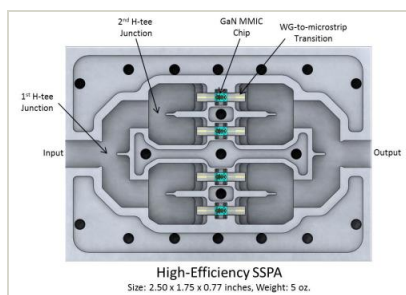


Organizations Performing Work	Role	Type	Location
Quinstar Technology, Inc	Lead Organization	Industry Small Disadvantaged Business (SDB)	Torrance, California
● Jet Propulsion Laboratory (JPL)	Supporting Organization	NASA Center	Pasadena, California

## Primary U.S. Work Locations

California

## Images



## Briefing Chart

High-Efficiency, Ka-Band Solid-State Power Amplifier Utilizing GaN Technology Briefing Chart  
(<https://techport.nasa.gov/image/130096>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Quinstar Technology, Inc

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

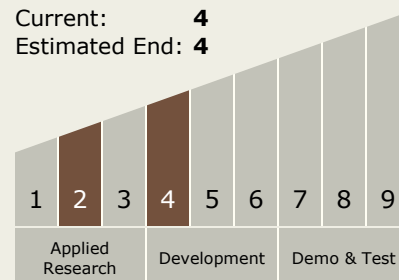
Carlos Torrez

### Principal Investigator:

James Schellenberg

## Technology Maturity (TRL)

Start: 2  
Current: 4  
Estimated End: 4



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## Technology Areas

### Primary:

- TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems
  - └ TX05.2 Radio Frequency
    - └ TX05.2.1 Spectrum-Efficiency

## Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System